# Langley Research Center General Aircraft Maintenance Manual for Research Services Directorate (RSD)

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| | | | Organizational Unit Manager | Date |

# Preface

### *General Aircraft Maintenance*

All aircraft assigned to NASA Langley Research Center (LaRC) are maintained and inspected in accordance with standard aircraft safety practices. This manual prescribes requirements pertaining to maintenance, repair, and modification of aircraft and equipment. It is not intended to cover every contingency that may arise or every rule of safety.

# Chapter 1

## *Introduction*

1.1 Purpose

The purpose of this manual is to establish aircraft and allied equipment maintenance procedures and practices.

1.2 Applicability

This manual applies to all organizational elements, experimenters, companies, and contractors performing maintenance or research modifications to aircraft under the control of the Research Systems Integration Branch (RSIB), Research Services Directorate (RSD), regardless of geographical location.

1.3 Governing Sources of Information

The instructions and procedures contained in this manual are not intended to replace or duplicate, but to clarify the governing documents. Personnel performing aircraft maintenance, modifications, and inspections are responsible for becoming familiar with the use of these documents as they pertain to their assigned tasks. The following is a list of supplemental information provided to assist in the completion of the assigned tasks.

A. LPR 1710.16 - Aviation Operations and Safety Manual
B. AF T.O. 1-1-1 - Cleaning of Aerospace Equipment
C. AF T.O. 1-1-2 - Corrosion Prevention and Control for Aerospace Equipment
D. AF T.O. 1-1A-8 - Structural Hardware
E. AF T.O. 1-1A-14 - Aircraft Electrical and Electronic Wiring.
F. AF T.O. 00-20-5 - Aircraft and Engines Flight Reports and Supporting Maintenance Documentation
G. AF T.O. 00-25-172 - Ground Servicing of Aircraft and Static Bonding
H. AF T.O. 4T-1-3 - Inspection Maintenance Instructions, Storage and Disposition of Aircraft Tires and Inner Tubes
I. FAA Advisory Circular 43.13-1B/2A - Acceptable Methods, Techniques, and Practices, Aircraft Inspection, Repair and Alterations
J. LaRC, Foreign Object Damage (FOD) Program. See Chapter 11.
K. LaRC, Oil Analysis Program. See Chapter 12.
L. LaRC, Nickel Cadmium Battery Maintenance Procedures. See Chapter 13.
M. LaRC, Quality Assurance Office Procedures and Documentation Instructions. See Chapter 10.
N. LaRC, Tool Control Program. See Chapter 14.
O. LaRC, Safety Manual – LPR 1700 series
P. Aircraft Crash Rescue Handbook
Q. MIL-STD-810E - Environmental Test Methods and Engineering Guidelines
R. RTCA/DO-160 - Environmental Conditions and Test Procedures for Airborne Equipment
S. AF T.O. 8-1-1 - Aircraft Electrical System Inspection Procedures
T. NASA-STD-8739.3, Soldered Electrical Connections
U. MIL-W-5088L - Military Specifications Wiring, Aerospace Vehicle
V. AF T.O. 1-1A-9 - Aerospace Metals, General Data and Usage Factors
W. NASA-STD-8739.4, Crimping, Interconnecting Cables Harness, and Wiring
X. NASA-STD-8739.7, Electrostatic Discharge Control
Y. Langley Management System (LMS)

1.4 Organization

The Research Services Directorate (RSD) is responsible for maintenance of and modifications to aircraft as specified in Section 1.2 of this manual. The organizational structure can be found in LMS-OUP-D1.

# Chapter 2

***Procedure/Authority/Responsibility***

2.1 Procedure

All LaRC-assigned aircraft are maintained as public use or as certified aircraft using maintenance criteria published by the manufacturer, FAA, or military services as guidelines. In addition, all aircraft assigned to LaRC are classified as either Research or Program Support. The Lead, Quality Assurance Office, with concurrence by the Head, Research Systems Integration Branch(RSIB) and Director, RSD is responsible for establishing inspection intervals.

A. Research aircraft, such as prototypes, modified airframe/powerplants, platform, and testbeds are used for research and development
B. Program Support aircraft are used to support research and development programs, pilot proficiency, chase/photography, and transportation of research personnel.
C. The Director, RSD following NPR 7900.3 may move aircraft from one classification to another to support Langley Research Center missions.

2.2 Authority

The authority to perform maintenance and to ensure airworthiness of aircraft at LaRC is delegated downward through the Center's chain of command:

- Center Director
- Associate Director for Operations
- Director, RSD
- Head, Research Systems Integration Branch, RSD

2.3 Responsibilities

A. *Director, RSD* - responsible for overall safety procedures and policies for maintaining and modifying aircraft assigned to the Center.
B. *Head, Research Systems Integration Branch* - responsible for:
   - Establishing and implementing procedures for the maintenance, alteration, and servicing of all aircraft and associated ground support equipment
   - Designating, evaluating and administering certification of personnel within the Branch
   - Assuring that all assigned Crew Chiefs and other personnel perform maintenance in a safe and efficient manner
   - Ensuring that each person is qualified for their particular task, and that their certification records are current
C. *Senior Maintenance Technician of the Research Systems Integration Branch*- responsible for:
   - Team assignments and the movement of personnel as workloads fluctuate
   - Guidance and leadership of junior level technicians
   - Assisting the Branch Head in formulating and implementing procedures and instructions
D. *Senior Electronics Technician of the Research Systems Integration Branch* - responsible for:
   - All maintenance and modifications on avionics and electronic equipment
   - Maintenance of aircraft batteries for all assigned Research Systems Integration Branch aircraft
   - Experimental system interface with basic aircraft wiring
   - Maintenance of the personal survival equipment
E. *Site Supervisor for the Support Aircraft Team* - responsible for:
   - Maintenance and modifications to assigned aircraft
   - Ensuring that all assigned personnel are qualified or being trained under qualified personnel and that all certification records are current

F. *Crew Chiefs, technicians and mechanics assigned to the Research Systems Integration Branch* - responsible for:
   - Performing all assigned functions safely and efficiently
   - Performing only those duties for which a current certification is on file, training is in progress, or has been approved by the functional supervisor
   - Keeping up-to-date on the latest technical and safety publications in the assigned area of expertise

G. *Operations and Engineering Branch* - responsible for:
   - Provide pilots to support aircraft/simulation programs for RSD
   - Tactical planning and implementation of flight research missions
   - Flight Operations Support Center operations and maintenance
   - Provide meteorological services for flight operations and emergency weather information

H. Airworthiness & Configuration Management. Airworthiness and Configuration Management is provided by RSD Airworthiness Engineers and are the focal point for aircraft and research systems modification and operational airworthiness assurance. Airworthiness responsibilities include, but are not limited to:
   - Reviews engineering designs, aircraft modifications, and equipment installations.
   - Maintains configuration management of baseline LaRC aircraft and research system integrations.
   - Reviews and signs program initiations and change requests, work orders and hazard analyses.

J. *Quality Assurance Office* - responsible for:
   - Oversight of maintenance and inspections using LMS-OP-0912
   - Ensuring safe integration of research equipment
   - Maintaining the historical records for all assigned aircraft
   - Reviewing directives as received from other governing bodies using LMS-OP-0911
   - Maintaining a technical library that will aid in the maintenance of the aircraft and systems (see Chapter 4 for additional information)

# Chapter 3

## *Qualification and Certification Requirements*

3.1 Flight Crews

Refer to LPR 1710.16 for the qualification and certification of flight crews.

3.2 Maintenance

The Senior Maintenance Technician and the Senior Electronics Technician of RSIB are responsible for making all maintenance personnel job assignments based on the experience and skill level(s) of the individuals.

Experience and skill level(s) is based upon:

- Previous employment
- Education
- Level and type of certification or license held
- Level of on-the-job training completed

All civil service maintenance positions are filled either internally LMS-CP-4302 or via outside hiring using LMS-CP-4303.

3.3 Quality Assurance

The Lead, Quality Assurance Office is responsible for making all job assignments based on the experience and skill level(s) of the individuals. All civil service positions within the Quality Assurance Office are filled either internally using LMS-CP-4302 or via outside hiring using LMS-CP-4303.

3.4 Training

The Senior Maintenance Technician is responsible for working with the RSD Training Coordinator in assessing training needs and updating the RSD Required Training Needs and Record Form for the Research Systems Integration Branch and coordinating the training of assigned personnel.

The Lead, Quality Assurance Office is responsible for working with the RSD Training Coordinator in assessing training needs and updating the RSD Required Training Needs and Record Form and coordinating the training of assigned personnel.

Approved training is received in the following methods:

- Formal commercial or military maintenance training courses on aircraft, engines, systems, and/or related components
- On-the-job training under more experienced personnel
- On-site training using LMS-CP-4316 for related items such as lifting procedures, forklift, crane, highlift vehicles, and fuel truck operation
- On-site/In-house periodic training on safety related items such as the hangar fire system, fire extinguishers, FOD prevention, chemicals, emergency response, and hearing conservation
- Formal commercial or military training courses or on-the-job training on airframe, engines, systems, test equipment and/or related components

## 3.5 Certification/Re-Certification/Qualification Cycle

- The Head, RSIB is responsible for ensuring all certification/re-certification requirements are met by civil service personnel and for updating the RSD Record Form and the Required Training Needs and Record Form when this training is complete.
- All certification and re-certification requirements must meet Center guidelines and RSIB requirements.
- Copies of all formal training received by civil service employees are maintained in personnel folders maintained at branch level with original to Office of Human Capital Management for inclusion in the official personnel folder. Certification of all Contract employees' formal training is maintained in a manner and location as specified by their employment office.
- A computer file is maintained on particular tasks, such as egress system maintenance, jacking, towing, servicing oxygen systems, servicing fuel, engine run up, operation of various ground support equipment, operation of specialized electronic equipment and soldering of electrical connections, that require annual certification

The Senior Maintenance Technician, the Senior Electronics Technician, and the Site Supervisor for the Support Aircraft Team, of the Research Systems Integration Branch are responsible for:

- Ensuring individual qualification records are current
- Ensuring individuals are re-certified as required
- Notifying the RSD Training Coordinator of formal training requirements

The Lead, Quality Assurance Office is responsible for:

- Ensuring individual qualification records are current
- Ensuring individuals are re-certified
- Notifying the RSD Training Coordinator of formal training requirements

# Chapter 4

## *Quality Assurance/Inspection*

4.1 System

The Quality Assurance Office of RSD performs all quality assurance duties and technical inspections for aircraft maintenance, experimental system modifications or equipment modifications, and installations of experimental equipment. Duties include:

- Inspecting LaRC aircraft to ensure maintenance is in accordance with all appropriate civil or military standards
- Inspecting and approving the installation of all research equipment and modification to LaRC aircraft regardless of operator and geographical location
- Acceptance inspections of all aircraft and aircraft-related parts/hardware received at LaRC
- Maintaining documentation verifying that all aircraft assigned to, or under the control of, LaRC have been maintained, inspected, and/or modified according to engineering drawings, applicable standards, service bulletins, technical orders, airworthiness directives, advisory circulars, and other pertinent information
- Recording modifications required by Service Bulletins, Service Letters, Airworthiness Directives, etc., on the appropriate forms using LMS-OP-0911
- Initiating special inspection requirements or maintenance practices affecting the airworthiness of research aircraft or operations for specific research programs
- Reviewing mechanical and electrical drawings of proposed research equipment, designs, and installations prior to final release for fabrication and/or aircraft installations
- Maintaining a technical library for all assigned aircraft, to include airframe, powerplant, and accessories and filing of revisions to the manuals maintained and providing a minimum of one copy of the aircraft and maintenance manuals to RSIB for distribution and filing
- Maintaining a technical library of all flight manuals and associated checklists and providing a minimum of one copy to the Pilot's Office for distribution and filing
- Maintaining weight and balance control on all assigned aircraft, including the weighing of aircraft, calculating changes, and processing the appropriate forms
- Calculating forward and aft center of gravity, gross weight limits, and zero fuel limits that could exceed the aircraft limits
- Providing the Crew Chief on larger aircraft with a means for calculating the dispatch weight and balance of the aircraft that may affect take-off trim and power settings and ensuring that the calculations are performed, recorded, and provided to the pilot in command
- Alerting the ground and flight crews of possible problems
- Posting weight and balance information with the aircraft acceptance forms
- Ensuring that all RSIB test equipment, (except that controlled by the Electronic/Avionics unit) requiring calibration is submitted at prescribed intervals and that documentation is reviewed prior to returning the equipment to use using LMS-CP-0506
- Maintaining a technical file of military specifications, standards, drawings, and other civilian specifications required for supporting the assigned aircraft and research programs
- Maintaining a file of FAA Regulations, Advisory Circulars, and Airworthiness Directives to support the assigned aircraft
- Reporting major safety-related quality assurance discrepancies to the Safety and Mission Assurance Office

4.2 Designated Inspectors

The Director, RSD, the Head, RSIB, or the Senior Maintenance Technician, RSIB have the authority to clear "Red X" conditions if a Quality Assurance Specialist is not available. Note: The QA Office will designate by letter, contractor or NASA personnel to act as designated inspectors as required by mission needs. The contractor has authority to use designated inspectors in the maintenance task order.

4.3 Clearance Authority

All Quality Assurance Office clearances must be by signature, acceptance stamps, or a combination of the two.

# Chapter 5

***Aircraft Maintenance***

## 5.1 Civil Service Support

The Head, RSIB is responsible for all maintenance performed on aircraft assigned to LaRC by both civil service and contract personnel. Civil service employees are certified by job description only, although some may hold FAA or FCC licenses. See Chapter 2, Section 2.3 for details concerning the responsibilities assigned to the Head, RSIB.

## 5.2 Contract Support

Contract support is supplied as follows:

Performance Based Contractors (PBC) work within the structure of Research Systems Integration Branch to complete specific assignments to include:

- Maintenance and modifications to aircraft covered under the Task Order issued by the Site Supervisor
- Support to research programs as requested by the Head, RSIB
- Maintenance of personal equipment controlled by RSIB
- Quality Assurance Inspection for all basic aircraft maintenance covered under the Task Order issued by the Task Monitor
- Assist and or provide flight line support during flight operations

Services and Support Contractors work with RSD personnel from designated off-site locations to supply the following:

- Heavy maintenance
- Procurement
- Aircraft inspections
- Component overhaul/repair
- Repair and/or maintenance of engines and propellers

All Services and Support Contractors must have a current FAA Certificate to qualify as a repair station or be a Department of Defense (DoD) facility. Those contractors performing as a qualified repair station for the DoD must have a quality system conforming to DoD regulations. Those contractors performing under general service and support must use a quality control system that conforms to FAA regulation, Part 121 or 145. Service and Support Contractors are not permanently assigned to LaRC, but supply support on an as-needed basis with services/support delivered to a specified location.

## 5.3 Center Support

Specialized skills, such as nondestructive testing, welding, machining of parts, heat treatment, and material processing may be secured from other implementing organizations throughout the Center. In the event that implementing organizations opt to use contractor personnel in the performance of these functions, all received articles must be inspected using appropriate receipt and inspection procedures. Documentation of all inspections and quality assurance checks performed within the implementing organization must be supplied to the Quality Assurance Office, RSD for final approval.

Specific modifications made to aircraft must be classified as flight-critical or non-flight-critical. All flight-critical items require quality assurance be performed by the Quality Assurance Office as well as within the implementing organization. All inspections must be documented and a copy supplied to the Quality Assurance Office, RSD for final approval.

## 5.4 Flight Readiness Review(s) and Maintenance Test Flight(s)

A Flight Readiness Review (FRR) must be convened after a major inspection or modification and prior to the aircraft being released for flight. The FRR is used to inform all interested individuals of maintenance actions or modifications performed on the aircraft and to ensure that all have been completed and the aircraft is ready for flight.

A functional check flight is required for all aircraft where maintenance or modification(s) have been performed on a system that cannot be completely certified through ground based testing or is required by the particular maintenance manual, Time Compliance Technical Order, or Maintenance Work Order. Use of a test flight as a method to aid in the diagnosis of a discrepancy of a newly installed system is acceptable.

# Chapter 6

***Servicing/Cleaning/Corrosion Control***

## 6.1 Fuel Storage, Transportation and Servicing

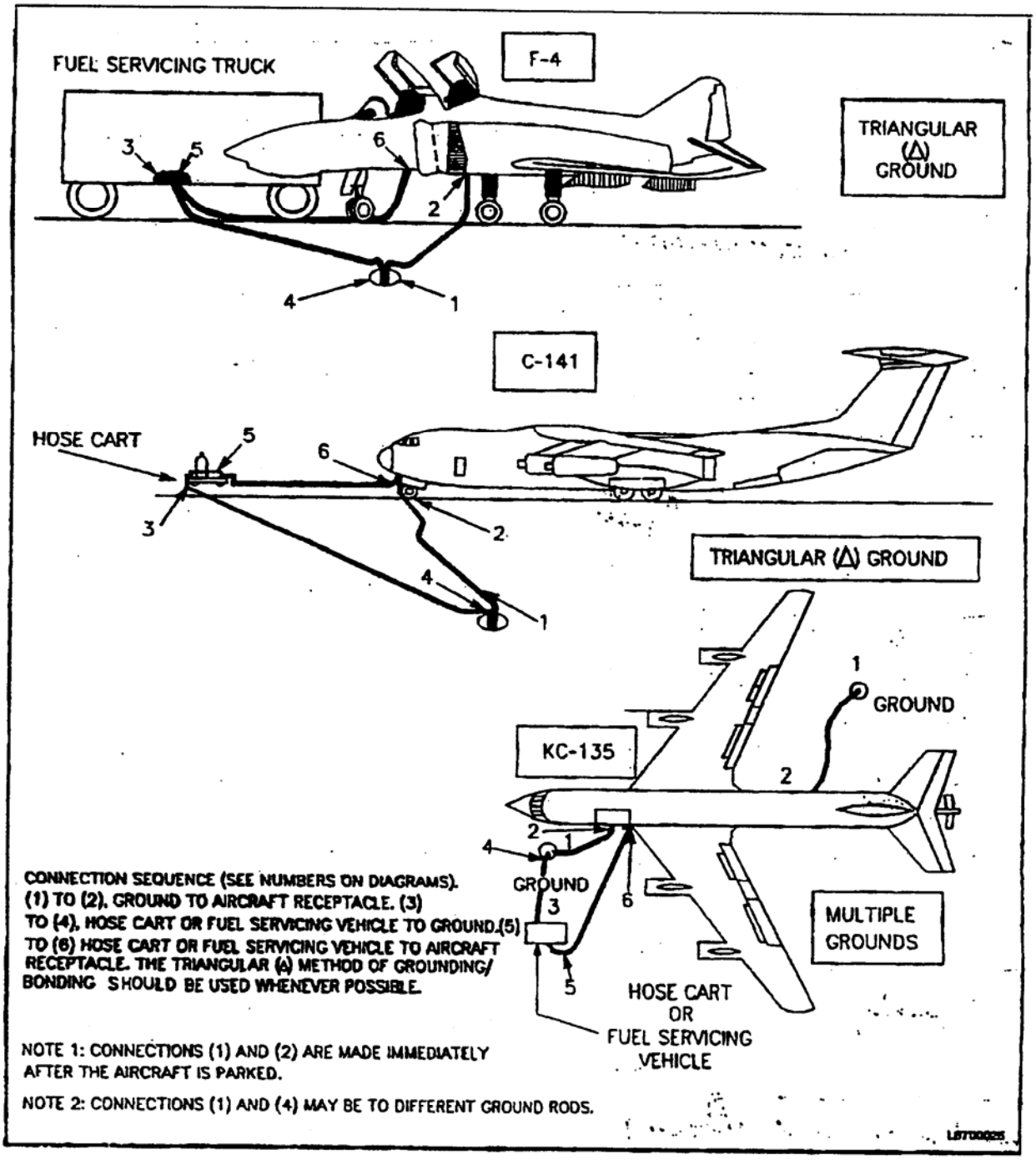
The Research Systems Integration Branch uses two methods of fuel storage: jet fuel (JP-5) is stored and serviced from tanker trucks; aviation gasoline (100LL) is also stored and serviced from an above ground tank. Motor vehicle gasoline is stored in an above ground tank. RSIB is responsible for maintaining the fuel trucks and the fuel tank as well as providing routine maintenance and filter changes on the storage tank at specified intervals. These maintenance functions must be performed using the approved manufacturer's specifications contained in the applicable Air Force Technical Publication and NASA guidelines. All fuel trucks must be parked inside a spill containment pad that meets Environmental Protection Agency (EPA) standards for reducing the impact of fuel spills when not in use.

## 6.2 Safety Requirements for Refueling/Grounding

Personnel performing fuel servicing operations must be thoroughly familiar with the applicable portions of Air Force T.O. 00-25-172. The transient flight crew must supervise fuel servicing operations to be performed on transient aircraft that are unfamiliar to RSIB personnel. The Senior Maintenance Technician, RSIB, must supervise the servicing when transient aircraft personnel are not available for this function.

The following safety provisions are to be observed as a minimum when performing fuel servicing:

- When positioning the fuel truck:
    1. Maintain 10-foot minimum distance between the aircraft and servicing vehicle.
    2. Do not park with vehicle facing aircraft.
    3. Always use chocks as well as setting parking brakes on servicing vehicle.
- Provide a LaRC-authorized three-point static grounding in the following order (see Figure 6-1):
    1. Static ground to the aircraft
    2. Servicing vehicle to static ground
    3. Servicing vehicle to aircraft
    4. Use only approved grounds that are identified with a valid test date
- Ensure that the single point nozzle is grounded and that the nozzle is connected to the aircraft (some hoses have ground wires).
- Ensure that a 150-pound halatron fire extinguisher or an approved substitute is available and positioned.
- Wear only cotton, non-static producing clothing that provides personal protection. Do **not** wear nylon clothing during servicing.
- Disconnect grounds in reverse order when servicing is complete.
- Return the servicing vehicle to the designated storage area and make appropriate log entries.




Static Grounding During Refueling/Defueling Operations

Figure 6.1

## 6.3 Defueling/Grounding

The following procedures must be used when defueling aircraft:

- Observe all requirements listed for refueling.
- Drain all water from aircraft sumps and check for contamination.
- Determine the type and grade of fuel in the aircraft and ensure that the correct truck or storage tank is used for defueling.
- Pump the fuel from the aircraft into the truck or storage tank.
- Drain all fuel that cannot be pumped from the fuel tanks into approved containers. Ground the containers and then bond them to the aircraft. **Caution:** DO NOT allow fuel being drained from sumps to free-fall. **Caution:** DO NOT use plastic or polyethylene buckets or pails for collecting or storing fuel.
- A fire/crash vehicle must be on the scene during all defueling operations. Only the Head, RSIB is authorized to waive this requirement.
- A person will be stationed on top of the defuel truck during the operation.

Use the following procedure when defueling operations involve an RSIB-assigned fuel truck:

- Remove the fuel truck from service and attach a red aircraft parts tag specifying the reason the truck is out of service and the aircraft that was defueled to the ignition key.
- Analyze a fuel sample for contamination by forwarding to Langley AFB Fuel Lab or by other suitable means.
- Return the truck to service if the fuel sample is acceptable. **Note:** The fuel truck will remain out of service if the sample is unacceptable and the aircraft that was defueled will be placed on a Red X condition and corrective maintenance actions initiated.

## 6.4 Contamination Checks

- Drain all fuel trucks prior to first use of the day to check for water and visually check for contamination.
- Physically sample all fuel trucks for contamination on a monthly basis and send the samples to Langley AFB Fuel Lab for analysis.
- Drain all aircraft fuel sumps on a daily basis prior to flight or 3 hours after servicing to check for contamination.

## 6.5 Off Base Refueling

The flight crew is responsible for ensuring that aircraft away from LaRC are:

- Serviced with the correct type and grade of fuel.
- All additives listed in operational requirements are added.
- Ensuring that the sumps are drained to check for contamination.

## 6.6 Oil Service

Oils currently in use fall into two classifications, mineral or synthetic. Each class consists of several different types and grades. Special care must be taken not to mix classes, grades, and types of oils:

- Store oils in marked dispensing units or containers furnished by vendors
- Separate the various types and grades of oil while stored in the same area
- Exercise extreme caution when handling synthetic oils to avoid absorption through the skin or damage to painted surfaces, rubber and other materials. **Note:** Clean up all spills immediately.
- Dispose of all drained or contaminated oil immediately using designated containers. **Note:** Dispose of the various types of fuels and oils separately.

Refer to Section 6.11 for additional information on hazardous waste disposal.

## 6.7 Oxygen Service

Oxygen in gaseous form is not flammable; however, it will support rapid combustion of most materials. It reacts violently to petroleum products if fire or a spark from static electricity is present.

The following safety precautions will be observed at all times during servicing operations:

- Only fully trained and certified personnel shall handle or service oxygen systems.
- Service according to manufacturer instructions and the applicable portions of Air Force T.O. 00-25-172.
- As a minimum two persons are required to service gaseous systems: one individual to watch the aircraft gages and the other to operate the gaseous system servicing cart.
- All power sources must be off, the aircraft parked 50 feet from any structure or spark-producing source, and clear of oil and fuel spills.
- Clothing, hands, and tools must be clean and free of oil and grease.
- Wear protective face shield when servicing gaseous systems.
- Ensure that a 150-pound halatron or equivalent fire extinguisher is available.
- **DO NOT** service oxygen systems simultaneously with other servicing operations.
- Ground the aircraft and the servicing cart. The cart requires grounding to the aircraft unless steel braided hose is used for servicing.

## 6.8 Tire Inspection/Storage/Servicing

- Inspect all tires for serviceability in accordance with the applicable aircraft maintenance manuals and Air Force T.O. 4T-1-3.
- Use only new tires as replacements. **Note:** Only the Head, RSIB has the authority to approve the use of recap tires.
- Ensure that tires with the correct speed and ply rating are installed upon the aircraft.
- Store new tires in a standing position.
- Use the tire safety cage for initial servicing of and standing time for high-pressure tires. **Note:** Appropriate tire inflation kits are furnished for each aircraft. For aircraft with tire pressures above 70 PSI, the kits must contain a pressure relief valve and a gage; for lower pressures, the kits contain a gage only. All kits must be maintained in accordance with LMS-CP-0506.
- Comply with specific instructions and safety precautions prescribed by the aircraft being serviced.
- Wear safety goggles or a face shield.
- Use only nitrogen for servicing aircraft tires with landing speeds above 100 knots.
- Use the calibrated tire inflation kit furnished for that aircraft, which has the specified relief valve setting.
- Stand forward or aft of the tire well out of the explosion area.
- Ensure that the tire is deflated prior to removing the axle nut when removing the wheel from the aircraft.
- Use extreme caution when working around an overheated tire. Approach from the front or from the rear. While injuries can still occur, this will give the best protection from an exploding tire.

## 6.9 Exterior/Interior Aircraft Cleaning

Cleaning of aircraft is required to remove deposits that lead to damage of parts and/or corrosion, to facilitate inspection, and to preserve appearance. Cleaning materials must be of a manufacturer's approved specification for the job. All safety precautions published for the product must be observed. If doubt exists, do not use the product.

- Exercise care to cover pitot/static openings and any other areas that can be damaged by cleaning products or water when cleaning the exterior of the aircraft.
- Do not spray cleaning agents directly on such items as wheel bearings, rod end bearings, electrical components, and hydraulic actuator pistons.
- Clean interior materials of plastic, leather, or vinyl with mild soap and water. Use only manufacturer's approved cleaning agents for stain removal or other cleaning of upholstery.
- Use a foam-type-cleaning agent for cleaning carpets not removed from the aircraft. Only the Head, RSIB has the authority to approve any substitutions in cleaning agents.
- Clean windows and canopies with soap and water or an approved cleaner only. Verify the type of material prior to cleaning in order to select the best method.

## 6.10 Corrosion Control

Corrosion control consists of the following specific preventive measures:

- Maintaining cleanliness of equipment.
- Treatment as corrosion occurs and restoration of protective finishes.
- Lubricate exposed areas of struts, cables and hydraulic cylinders according to manufacturer's specification.
- Spray corrosion inhibiting compounds according to manufacturer's specifications.
- Assuring that all drains are open and clear of debris and accumulated moisture is removed.

Consult with LaRC personnel or the manufacturer's representative for evaluation and recommended treatment procedures in cases where severe corrosion is found.

## 6.11 Hazardous Waste Disposal

All hazardous waste that is discarded by RSD personnel, must be disposed of in accordance with LaRC Hazardous Waste Disposal Practices. Any violation must be reported to the Head, RSIB.

# Chapter 7

***Ground Handling of Aircraft***

7.1 Taxiing

Only qualified flight crews are authorized to taxi aircraft assigned to LaRC. The Director, RSD has the authority to authorize other individuals to perform this function.

7.2 Towing

A tow director will be used when moving large aircraft or aircraft located in a congested area. The director will be positioned in a manner that allows the tow motor operator continuous visual contact with the director. The director is selected by the tow motor operator prior to starting the move. The director is responsible for ensuring that the tow motor operator, wing walkers and brake rider, are in position and ready to start the move. For towing a/c during non-standard duty hours, the requirement for wing walkers may be deleted, on a case by case basis, by the Head, RSIB or designate.

**Note:**
Wing walkers are used when towing aircraft in congested areas or when the tow director has any doubt about proper clearance from any object.

On smaller aircraft or in non-congested areas when a tow director is not appointed, the tow motor operator directs the towing operation.

All personnel involved in an aircraft move will have whistles (issued by RSIB) which will be blown when an emergency stop is required during the move.

Only maintenance or flight crew personnel certified on a particular aircraft by the Senior Maintenance Technician or Contractor Site Supervisor are authorized to perform towing operations while acting as the tow motor operator.

The tow motor operator is responsible for ensuring that:

- The tow bar is the specified type for the aircraft, that it is in a serviceable condition, and that it is connected.
- The tow motor is rated (draw bar rating) for the aircraft that is being repositioned.
- The specified gear locks are installed and the landing gear scissors are positioned.
- Towing speed does not exceed walking rate (5 MPH) for ramp or weather conditions.
- The aircraft is chocked, tow bar is disconnected, scissors are repositioned, and that the aircraft is statically grounded after positioning.

7.3 Arrivals/Departures

- Each Crew Chief or maintenance unit is responsible for launching and recovery, servicing and repositioning of assigned aircraft. The Head, RSIB, Senior Maintenance Technician, or Contract Site Supervisor has the authority to assign personnel to perform these functions in the absence of assigned crew.
- The Head, RSIB or the Senior Maintenance Technician assigns teams/units on a monthly basis to handle transient aircraft arrivals and departures. Only the Head, RSIB or the Senior Maintenance Technician has the authority to transfer personnel to supplement assigned teams/units when the need arises. Personnel meeting arriving transient aircraft determine from the flight crew if servicing is required, the expected departure time, if hangaring is required, and direct the flight crew toward the flight planning room.

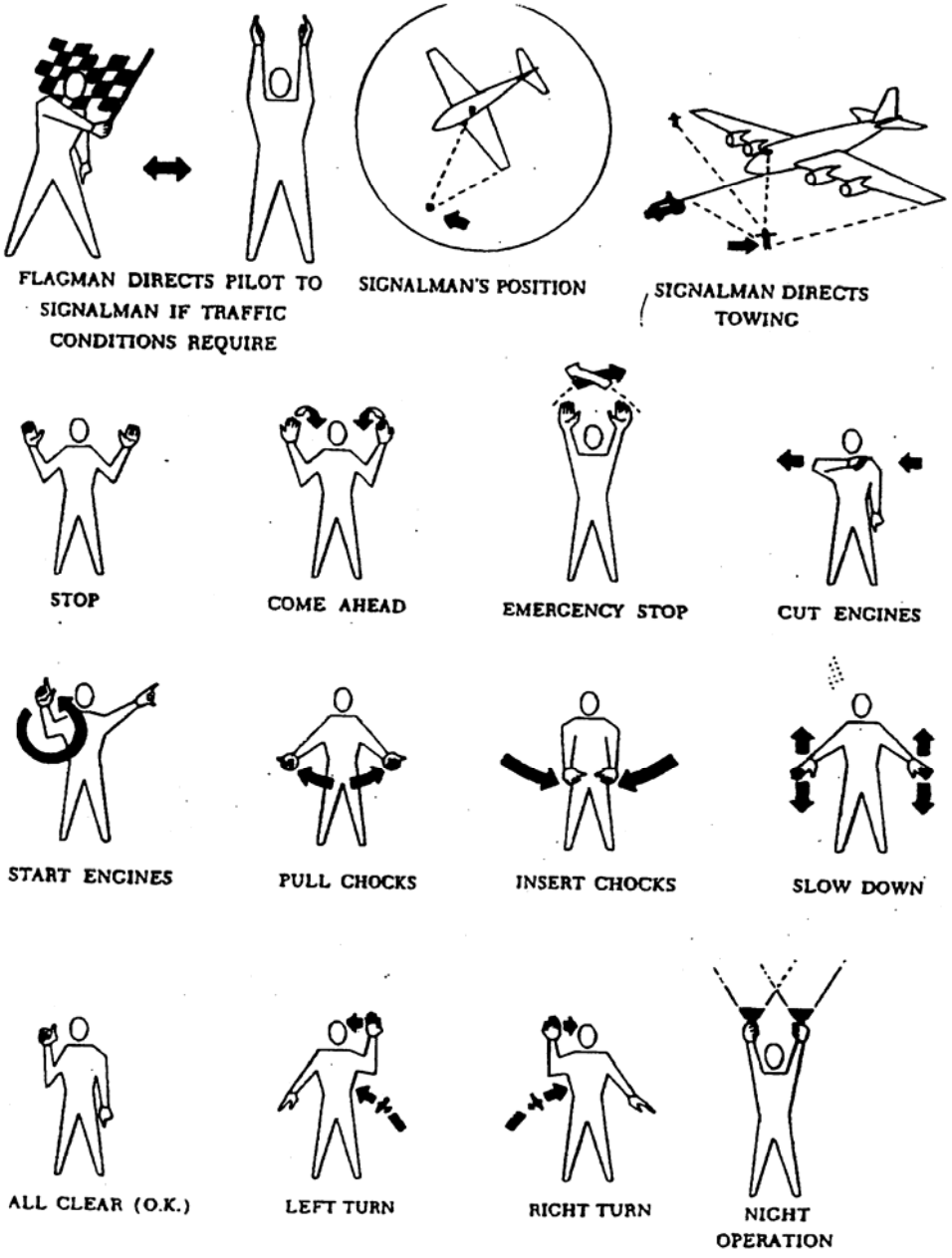
7.4 Engine Run Ups and Power Checks:

- Only qualified flight crews or maintenance personnel currently certified for a given aircraft are authorized to operate engines during maintenance checks.
- Perform engine runs in designated areas only.

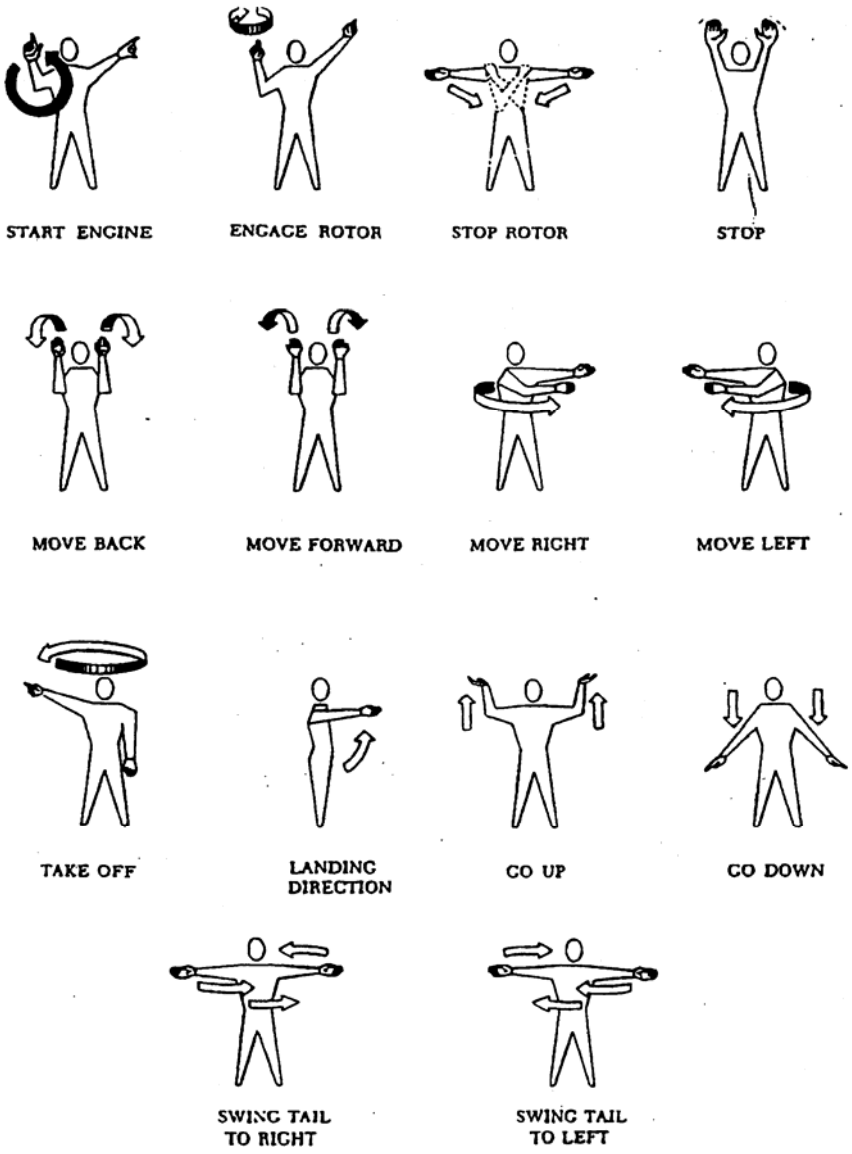
- High power turns on jet aircraft shall be conducted on the trim pad or designated Air Force area, using tie downs and/or restraints as directed by the original equipment manufacturer or NASA Langley policy.
- The following safety practices must be adhered to during engine runs:
  (1) Check emergency access area around aircraft for clearance.
  (2) Perform walk around inspection. Check intake for FOD and check inlet screen installation if applicable.
  (3) Check ramp for FOD and intakes or propellers for clearance.
  (4) Check that brakes are set, wheels are chocked, and aircraft is secured if required.
  (5) Check that a qualified fireguard is positioned and either a fire/crash truck or fire extinguisher is available
  (6) Observe danger zones of operation. Remain clear of intakes and exhaust areas, rotating propellers, and plane of rotation of propellers and turbine wheels
  (7) Check lists and operating instructions shall be adhered to during all engine runs

## 7.5 Aircraft Marshaling

Use the radio intercom for communication between the pilot and marshaler pertaining to operation of the aircraft systems on aircraft equipped with external intercoms. Use standard aircraft hand signals in cases of aircraft not equipped with external intercom capability. (See Figures 7-1 and 7-2 and Table 7.1) Pilot and marshaler must be constantly alert to ensure that no action is taken prior to a signal being given and acknowledged. Standard aircraft signals will be utilized.




Standard Aircraft Signals
Figure 7.1




Rotor Wing Aircraft Signals
Figure 7.2

A few specific signals are as follows:

| Signal | Pilot | Marshaler |
|---|---|---|
| *Apply external power to aircraft* | Hands above the head, left fist partially clenched, right hand moved in the direction of left hand, with two fingers inserted into circle made by left hand | Respond with like signal |
| *Disconnect external power from aircraft* | Reverses signal to apply power by withdrawing fingers of right hand from partially clenched left fist | Respond with like signal when power has been removed |
| *Apply external air to aircraft* | Left hand cupped, right fist fully clenched, fist moved in direction of left hand and inserted into cup made with left hand | Respond with like signal when completed |
| *Disconnect external air from aircraft* | Reverses apply external air signal by removing right fist from cupped left hand | Respond with like signal when completed |
| *OK* | Thumb and forefinger form a circle | Thumb and forefinger form a circle |
| *Speed brake operation* | Hands cupped, then open, then closed | Repeat signal prior to operation and gives "OK" signal when operation is completed |
| *Wing flaps down* | Hands in front, palms together horizontally, then opened at wrists | Repeat signal prior to operation and gives "OK" signal when operation is completed |
| *Wing flaps up* | Reverses wing flap down signal | Repeat signal prior to operation and gives "OK" signal when operation is completed |
| *Nose gear steering* | Hands at head level, palms towards marshaler, moves hands back and forth simulating movement of rudder pedals | Repeat signal prior to movement and gives "OK" signal when operation is completed |
| *Pitot heat check* | Grasps extended forefinger of left hand with right hand | Give "OK" signal if system is operating |

**Table 7.1**

# Chapter 8

***General***

8.1 Flight Request Procedures

The Director, RSD has the authority to issue flight request authorization according to criteria expressed in LPR 1710.16 and LMS-CP-0905.

8.2 Maintenance Release Procedures

- Use the LF 115 as the final maintenance release documentation. **Note:** The LF 115 takes the form of a traveler while the aircraft is in use and is made available to all appropriate maintenance staff during the flight.
- The Crew Chief is responsible for ensuring that all required entries on the LF 115 are completed prior to each flight and initialing the preflight completion. Items to be included are:
    1. Experimental
    2. DAS (Data Acquisition System)

**Note:** Leaving a line blank for an item that is not included on the aircraft or is not operational during a given flight is Not acceptable. Write N/A where appropriate.

- The Head, RSIB, the Senior Maintenance Technician, designated Senior-level technician, or Senior Electronics Technician must review the form for completeness, enter the date and sign the LF 115 in the designated area.

**Note:** Exceptional release procedures are contained in Chapter 10, paragraph 10.5 of this manual.

8.3 Life Support and Personal Equipment

The Crew Chief and the Senior Electronics Technician are responsible for maintenance of life support and personal equipment maintenance. Responsibilities include:

**Crew Chief:**

- Reviewing all aircraft forms each week to ensure that all items are inspected according to schedule
- Removal and installation of all aircraft items requiring inspection or maintenance

**Senior Electronics Technician:**

- Ensuring that all items are inspected, certified, and documented prior to returning the item to the Crew Chief for re-installation
- Tracking, performing, and documenting inspections of equipment not normally stored in the aircraft

8.4 Aircraft Fire and Evacuation Procedures

The Aircraft Crash Rescue Handbook details the fire, rescue, and evacuation procedures for each aircraft assigned and operated by LaRC. Periodic training and evacuation drills are mandatory for LaRC personnel that are required to fly on aircraft assigned and operated by LaRC. The Flight Systems Safety is responsible for ensuring that all LaRC personnel have received the mandatory training, and that the training is documented. Training records are stored under the direction of the Director, RSD and archived according to RSD Record Form. The Operations and Engineering Branch is responsible for ensuring that non-LaRC personnel flying aboard LaRC aircraft receive a safety briefing prior to flight and that the briefing be documented.

## 8.5 Hangar Fire and Evacuation Procedures

Building 1244 hangar, Building 1244 admin, Building 1244C and Building 1244D, are equipped with a fire warning and a fire protection system. A High Expansion Foam System protects the hangar area while a Water Deluge System protects the 1244D area. The Building 1244 admin and 1244C areas are protected by a sprinkler system throughout.

The warning system in ALL areas is activated automatically or by the individual discovering the fire. The High Expansion Foam System is activated automatically by IIIR/video detection system utilizing a cross-zoning method to lessen the possibility of erroneous alarms as well as erroneous releases. Cross-zoning requires detection by sensors in two different zones to allow automatic operation of the High Expansion Foam System. The hangar area is divided into 4 zones and each zone is equipped with a manual dump as well as a manual override station. The manual override system is installed in the event the erroneous alarm to prevent the system from dumping.

The deluge system in Building 1244D is activated automatically by high temperature sensors, rate of rise sensors or manually at one of the riser stations and is divided into two zones. A single zone or a combination of zones shall be activated as needed to suppress the fire.

These systems are inspected on a periodic basis and the appropriate safety personnel maintain documentation of the inspection.

ALL RSIB personnel are trained annually on the proper operation of the systems in 1244 Hangar as well as 1244D.

The Head, RSIB is responsible for documenting and maintaining records of this training according to the FRSD Record Form. Only RSD personnel are assigned to fire fighting squads.

In case of fire:
• Shout "FIRE" and activate the nearest pull station.
• Dial 911 to report the fire.
• Evacuate the area of non-essential personnel and do not re-enter until notified by the fire department of an "All Clear."
• Report to assigned squads, perform all safety and evacuation procedures assigned to the squad, and assist the fire department if requested.

## 8.6 Ground Support Equipment Maintenance

A performance-based contractor is responsible for maintenance of ground support equipment. All equipment is inspected or serviced at predetermined intervals. Unscheduled maintenance is performed with support from the LaRC Vehicle Maintenance personnel or support contractor. Inspection records or logbooks must be maintained to schedule and document work.

For Vehicle Maintenance maintained vehicles, all logbooks and inspection records are maintained in Vehicle Maintenance and updated by the personnel performing the maintenance activity.

Training in the use of ground support equipment includes:

- Use of maintenance stands
- Use of compressors
- Use of hydraulic machines and safety precautions to be observed
- Use of rectifiers and safety precautions to be observed
- Use of jacks and safety precautions to be observed
- Operation and licensing of motor vehicles such as fuel trucks, tow motors, forklifts, and high-reach vehicles or cranes

Training records are maintained by the Head, RSIB according to the RSD Record Form.

## 8.7 Housekeeping

Good housekeeping is an important requirement for an effective maintenance operation. Good housekeeping enhances fire prevention, safety, and appearance in the work area.

Housekeeping includes:

- Do not store flammable liquids in open containers. Use approved safety cans or small plastic bottles only and place in flammable storage lockers. **Note:** Mark all containers clearly as to contents using appropriate labels.
- Smoking is prohibited in all areas of the hangar, hangar annex, and within 50 feet of any fuel truck, fuel storage tank, or aircraft.
- Ensure that all fire protection equipment and fire lanes are clear of obstructions at all times.
- Keep parked aircraft and equipment clear of hangar doors.
- Use static grounds on all hangared aircraft and on all aircraft left on the ramp for extended periods of time.
- Use drip pans to prevent spills in the hangar area and ramp. Immediately clean up all fuel, oil, grease and similar material spills. **Note:** Use the hazardous material spill unit for cleaning up spills.
- Clearly mark with a streamer or protective device all instrumentation booms, wing tips, flight control surfaces, tail surfaces, antennas or other areas of the aircraft that pose a hazard to personnel.
- Ensure that all areas immediately adjacent to, and particularly under, all aircraft are kept clear of equipment.
- Unplug and disconnect all electrical equipment, extension cords, power units, power cables, and air hoses at the end of the workday.
- Cover all air hoses, electrical cords, hydraulic hoses, and cables that traverse walkways with a clearly marked metal cover.
- Remove all equipment from the work area and store in the designated area when no longer in use.
- Do not leave tools, parts, or other items on maintenance stands or aircraft in an unsafe manner.
- Keep all workbenches and toolboxes in a clean and orderly fashion.
- Keep the floor and ramp clean and FOD-free.

## 8.8 Personal Protective Equipment

- Use safety glasses, goggles, or face shields when grinding, cutting or sawing metals, plastics or wood and while handling volatile, corrosive, or pressurized fluids.
- Wear gloves appropriate to the material being handling when handling acids or other materials that cause burns or can be absorbed through the skin.
- Wear approved hearing protection at all times when noise conditions are extreme. **Note:** Hearing protection is made readily available at the entrance to the hangar.
- Wear hard hats in designated areas at all times. **Note:** Hard hats are available at the RSIB stockroom.
- Wear shoes with non-slip soles. **Note:** Safety shoes are suggested, but not required.
- Do not wear loose fitting clothing that could become entangled in rotating or reciprocating machinery.
- Avoid wearing jewelry when possible while working hot electrical systems. Bind rings that cannot be removed with tape when working around batteries, energized electrical equipment or when working in confined areas.
- Wear a safety harness when working out of high-reach equipment or on scaffolding. **Note:** Safety harnesses are available in the RSIB stockroom.

## 8.9 Safety Precautions

- Use explosion-proof or vapor-proof lights in and around the aircraft. **Note:** The Lead, Quality Assurance Office is responsible for approval of fluorescent light fixtures or other substitutions. All lights must be maintained safely and securely.
- Explosion-proof lights and air driven drill motors are available in the RSIB stockroom when required.
- Keep all electrical connections at least 18" from the floor. Do not plug or unplug equipment under load.

- Do not use any electrical equipment that produce sparks or operates with surface temperatures over 600$^{o}$F without special precautions. The Head, RSIB or the Senior Maintenance Technician must approve all special precautions.
- Use only approved heat guns or lamps to shrink electrical insulation, splices, and zaps or to troubleshoot heat-related discrepancies.
- Use only air-driven power equipment/tools on the aircraft and ensure that the air source is regulated to specified pressures for the particular equipment being operated. **Note:** The Lead, Quality Assurance Office must approve all special electrical tools prior to use.
- Battery powered drill motors, OSHA approved, are provided for use in the hangar. The drills will not be used in fuel cells/tanks, wheel-well, or other areas where there may be trapped fuel fumes. The drill motors are to be turned into the stockroom after use for charging/servicing.
- Use the spray booth in B1244D for spray painting. **Note:** The Head, RSIB must approve large spray painting operations conducted in the hangar. All health and safety precautions and applicable NASA/EPA regulations must be followed while painting. Safety permits will be obtained when required.
- Weld materials in designated areas only and ensure all fire and safety precautions are followed during the operation. **Note:** Weld components installed on the aircraft only when the part cannot be removed. **Note:** A fireguard from the fire department must be present during all welding operations performed in the hangar.
- Equip all ground support equipment or motor vehicles operated inside the hangar or on the ramp with spark arrestors and ensure that all other vehicles, such as delivery trucks, remain clear of parked aircraft.

## 8.10 Receiving Inspection

- Receiving inspection is performed on all parts received for entry to the spare part inventory or installation on the aircraft. It is the ultimate responsibility of the Quality Assurance Office to ensure that all parts received meet specifications and any nonconforming parts are documented. All nonconforming parts received through a NASA purchase request, credit card buy, or through a contract must be rejected and returned through channels prior to the part entering into the spare part inventory or installation on the aircraft.
- All parts determined to be nonconforming during inspections, troubleshooting, or as the result of a failure must be tagged with approved LaRC or DoD disposal tags and forwarded to the procurement specialist for processing.
- The procurement specialist is responsible for contacting the part vendor to determine the acceptable disposition of the part and document the same. **Note:** All aircraft parts and materials shall go through the procurement specialist.

## 8.11 Customer Supplied Parts

- All customer-supplied parts and equipment intended for flight arrive at the aircraft through the work order process and are considered to be RSIB property. The Crew Chiefs are responsible for ensuring the safety and security of the parts and equipment received.
- All customer-supplied parts and equipment not intended for flight (i.e. storage only) are considered to be RSIB property and must be secured by branch personnel.

## 8.12 Controlled Stores

Follow LMS-CP-5514 for controlled stores within the hangar. The Research Systems Integration Branch has three areas for storing inventoried parts, which are considered controlled stores. The Quality Assurance Office must inspect all parts prior to the parts being placed into storage.

- Stockroom: Only RSIB personnel have access to this area. All materials removed are recorded with part number and quantity.
- Aircraft spare parts inventory: Distributed throughout the hangar and annex storage areas and labeled to show aircraft registration number and identification. Only Research Systems Integration Branch personnel have access to these areas. All parts removed are recorded with part number and quantity.
- Avionics spare parts inventory: Controlled by avionics personnel with access by RSIB personnel only. All inventoried parts removed are recorded with part number and quantity.

# Chapter 9

***Maintenance of Aircraft Systems and Components***

9.1 Isolation/Deactivation and Reactivation of Aircraft Systems

The Head, RSIB is responsible for ensuring that all technicians performing maintenance work on the aircraft are cognizant of the approved method of isolating, deactivating, and reactivating "hot" circuits and pressurized systems during maintenance activities.

The steps below outline the method to be followed:

- Identify the circuits or systems to be isolated.
- Open the circuit breakers and collar or tag them.
- Place approved tags on the controls to be isolated.
- Inform the Crew Chief that the system has been deactivated. The Crew Chief is responsible for advising the maintenance crew and other pertinent individuals of the system deactivation.
- Remove the tags on the controls that were isolated.
- Remove the collar and tags from the circuit breakers and reset the breakers.
- Inform the Crew Chief that the system has been activated. The Crew Chief is responsible for advising the maintenance crew and other pertinent individuals of the system activation.

**Note:** Consider all wires "hot" until proven otherwise when troubleshooting an electrical or electronic system.
**Note:** Tag circuits/systems yourself. Don't rely on someone else to do it for you.

9.2 Electrical Systems

Only Research Systems Integration Branch Crew Chiefs or technicians with support from the Electronic/Avionics Unit personnel are authorized to perform maintenance on these systems. Extreme caution must be taken while working on or around electrical systems or components to avoid damage to equipment and personnel. The following apply in addition to the steps outlined in Section 9.1:

- De-energize all electrical circuits during maintenance except in cases where an energized circuit is required to perform the task and alert all other maintenance personnel who are performing activities on the aircraft.
- Ensure that the correct size, type and rating of wire is selected for installation when the requirement exists to replace wiring.

9.3 Avionics, Radio Navigation, and Radar

Only qualified Research Systems Integration Branch Technicians, using all applicable technical publications, are authorized to perform work on these systems. The general precautions described under Sections 9.1 and 9.2 apply when performing maintenance and/or troubleshooting of a system. The following applies in addition to those previously stated:

- Perform repairs to communications equipment in the Electronic/Avionics Laboratory when the task permits.
- Do no operate, test or check radar or radio transmitting equipment installed on the aircraft within 100 feet of activities involving fueling, de-fueling, tank repairs or other similar activities.
- Cordon off a 100 foot area or specific area designated by manufacturer in front of the radar antenna to provide a safe work area during testing of aircraft radar systems.

## 9.4 Aircraft Batteries

The Crew Chief is responsible for daily inspections, corrosion and tension checks on connectors, and removal/installation of batteries. The Electronics/Avionics Unit is responsible for performing capacity and deep cycle checks.

- Ensure that all basic aircraft batteries are maintained per LMS-TD-0957 or LMS-TD-0965. See Chapter 13 of this document for additional information
- Service lead acid batteries from rented, leased or transient aircraft according to manufacturer's specifications. See Chapter 13.
- Maintain special batteries such as IRU, INU, ADAIRS and flight control according to manufacturer's specifications

## 9.5 Hydraulic Systems

Only qualified Research Systems Integration Branch Technicians are authorized to perform work on hydraulic systems with fabrication support provided from other qualified sources. In addition to the steps outlined in Section 9.1, the following apply:

- Use only specified materials when performing maintenance.
- Ensure that tubing, fittings, hoses, seals, and fluids meet the requirements of the system. **CAUTION:** Particular care must be taken to prevent mixing of synthetic fluids such as Skydrol or Hyjet IV with mineral oils. While MIL-H-5606 and MIL-H-83232 are chemically compatible, the fire retardant properties of MIL-H-83232 will be lost if the two are mixed.
- Do not allow foreign material to enter the system.
- Cap or plug disconnected lines.
- Perform all maintenance with the pressure source disconnected and residual pressure bled from the system whenever possible. **Note:** Extreme care must be taken when pressure checking the system. Shut down the system if a leak occurs since fluid under pressure can form a mist that can be flammable or produce toxic vapors. Never check hidden areas for leaks with bare hands. Never tighten a leaking line while pressure is on the system.

## 9.6 Pneumatic Systems

Research Systems Integration Branch Crew Chiefs and technicians are responsible for maintenance of pneumatic systems. In addition to the steps outlined in Section 9.1, the following apply:

- Install ground locks prior to entering areas such as missile bays and wheel wells that have fast-actuating doors operated by pneumatic actuators.
- Ensure that the pressure has been depleted prior to performing maintenance on a system.
- Reset valves to the correct position prior to servicing air bottles or accumulators. **Note:** Exercise extreme caution when servicing these units, especially when contained in canopy removal and emergency gear extension systems.
- Constantly monitor gages on both the aircraft and the servicing cart to avoid over-pressurizing the units and/or system.

## 9.7 Landing Gear, Wheels, Brakes

Only qualified Research Systems Integration Branch Crew Chiefs and technicians, using appropriate manufacturer's and technical manuals, are authorized to perform maintenance on theses systems.

The following safety precautions must be followed when performing maintenance functions on landing gear, wheels, brakes and tires:

- Never enter a wheel well area unless ground locks have been installed and/or the system is de-energized. (See Section 9.1 for information on isolation of systems).
- Never work on or around the landing gear when the brakes are overheated from landing or taxiing.
- It is the responsibility of the task lead to ensure that the area is clear before actuating the gear up or down.
- Use reduced pressure/flow when possible on hydraulically operated gears during the initial cycle.
- Shut off power on electrically operated gears if a malfunction occurs.

- Exercise extreme caution when working with used brakes as the residue produced from lining wear poses a health hazard.
- Read and follow instructions when assembling or re-assembling brakes. Do not assume that the brake was assembled correctly.
- Follow the procedures listed in the maintenance manual exactly when bleeding brakes to ensure desired results.
- Ensure that all aircraft wheels have a nondestructive inspection at each tire change. Only the Head, RSIB and the Lead, Quality Assurance Office are authorized to deviate from this requirement. **Note:** Support for nondestructive inspections are available from other sources, both on-site and through contract organizations. Consult with the Head, RSIB or the Lead, Quality Assurance Office for guidance.
- Always deflate the tire prior to removing the axle nut and removing the wheel from the aircraft.
- Read and follow the published procedures for wheel bolt torquing when reassembling wheels.

## 9.8 Aircraft Jacking Procedures

Only currently certified personnel or personnel in training under a currently certified individual are authorized to perform jacking operations.

The following safety precautions must be followed when performing aircraft jacking operations:

- Read and follow the maintenance manual for the aircraft paying particular attention to the precautions listed.
- Inspect the jacks before use to ensure correct load capacity and serviceability. **Note:** Verify the pressure gage has a current calibration label according to LMS-CP-0506.
- Rope off the area and post danger signs prior to jacking the aircraft. **Note:** Only personnel required for the operation are allowed within the roped-off area.
- Release the parking brake prior to raising the aircraft and raise the aircraft in as nearly a level attitude as possible. Consult the technical manuals for leveling procedures in cases where the aircraft sits at extreme attitudes. **CAUTION:** Always use the ram lock ring when raising or lowering the aircraft. This ring must be kept within 1 inch of the bottom of the ram in the event of a seal failure to prevent a collapse of the jack. When the aircraft has been raised, the lock ring will be down and locked. It is the responsibility of the jacking supervisor to ensure that the lock rings are used. **Note:** Be especially careful when lowering the aircraft and removing the jacks as aircraft struts can stick and collapse inadvertently, causing damage to the aircraft.
- Ensure that all toolboxes and maintenance stands have been removed from the area prior to lowering the aircraft
- Verify the individual aircraft jacking point maximum load limit using the manufacturer's maintenance manual.

## 9.9 Aircraft Control Systems

**Note:** Take every possible precaution to prevent accidental movement resulting in personal injury or damage to equipment when working on aircraft controls.

Only qualified Research Systems Integration Branch personnel are authorized to perform maintenance on aircraft control systems. Personnel must follow the maintenance procedures in accordance with the manufacturer's maintenance manuals.

Only RSIB personnel are authorized to install Control Position Transmitters (CPT) or other units that are to be mounted on or attached to the aircraft controls.

Crew Chiefs and crew members are responsible for assisting in the calibration of equipment when it involves the movement of control surfaces.

The following safety precautions must be followed in addition to those outlined in the manufacturer's maintenance manuals:

The task lead is responsible for ensuring that all other personnel and equipment are clear of the aircraft when performing checks or preflight inspections that require movement of controls. **Note:** Personnel must be posted to prevent entry into danger zones and to monitor control surface deflections when working on large aircraft where controls cannot be seen from the cockpit.

- Communications must be maintained at all times with the cockpit operator. Use aircraft intercom or portable radios when available. If no electronic communications capability is available, use of hand signals is acceptable. See Figures 7-1 and 7-2 as well as Table 7.1 for approved hand signals.
- Ensure that the power source is off, if applicable, and that the cockpit controls are tagged out. See Section 9.1 for information on system isolation.
- Use control locks when working around flight control surfaces.
- At least two qualified maintenance personnel must be present when rigging flight control surfaces: one person operating the controls from the cockpit, and the other person monitoring movement from the ground. Announcements must be related to the movement of the aircraft in flight and maintained as follows: the person stationed in the cockpit announces the control movement; the person on the ground announces the movement of the flight control surface. Positions will be reversed and the checks repeated at the end of the session. **Note:** The Quality Assurance Office will complete the same exercise to perform the final inspection once the maintenance crew personnel have finished and sign the LF 781A.

## 9.10 Pilot Escape Systems (Ejection Seats and Canopies)

Only personnel who are currently certified and trained on the pilot escape systems installed on a given aircraft are authorized to perform maintenance functions. Exercise extreme caution when working on ejection systems and installing new equipment on the aircraft to ensure that it does not interfere with the operation of the escape system.

The following safety precautions must be observed when performing maintenance on these systems:

- Install ground safety pins immediately after flight. **Note:** Remove these pins only for flight or when required to perform system maintenance.
- All cartridges, initiators, ejection seats, and other pyrotechnic devices must be stored in the pyrotechnics locker in the Ejection Seat Room when removed from the associated system.
- Perform all maintenance on the ejection seats in the Ejection Seat Room.

## 9.11 Aircraft Engines and Propeller Systems

Only qualified RSIB personnel or contracted support personnel are authorized to perform maintenance functions on these systems. **Note:** All adjustments made are by nature flight critical. All manufacturer's technical and maintenance manuals must be strictly followed.

The following safety precautions apply in addition to those outlined in the manufacturer's technical and maintenance manuals:

- Always assume the magnetos are "hot" when working on reciprocating engines.
- Remain clear of the prop arc if a propeller must be moved on a warm engine (to attach tow bar).
- Exercise caution when performing control and fuel pressure checks, even when magnetos are off, to prevent accidental operation.
- Avoid contact with areas that have exhaust deposits.
- Perform all ground operation procedures according to Section 7.4 of this manual.
- Whenever an aircraft is down for extended maintenance or modification, the engine plugs will be removed and desiccant plugs installed.

## 9.12 Aircraft Weight and Balance

The Quality Assurance Office is responsible for:

- Ensuring that all aircraft assigned to LaRC are weighed once every 3 years at a minimum.
- Ensuring that weight and balance measurements are computed following each major modification to the aircraft.
- Ensuring that all measurements are taken using the equipment and procedures specified by the manufacturer.
- Ensuring that all measurements are documented and distributed to the Crew Chief, the flight release board maintained in the Planning Room (B1244, R136A) and the pilot.

## 9.13 Fuel and Oil Systems

Only qualified RSIB personnel, using manufacturer's technical and maintenance publications, are authorized to maintain these systems. **Note:** Exercise special caution when performing these maintenance functions to avoid fire or explosion.

The following safety precautions apply in addition to those outlined in the manufacturer's maintenance manuals:

- Drain, purge and check the fuel cell for explosive gasses prior to performing maintenance on an open fuel cell or hangaring an aircraft with an open fuel cell.
- Secure a safety permit according to LPR 1740.2 prior to personnel entering any fuel tank.
- Use only approved breathing equipment and personal protection equipment when entering any fuel tank. **Note:** Approved breathing equipment is available in the hangar.
- Always use the buddy system and station standbys when entering any fuel tank. Refer to LPR 1740.2 Section 4.4 for additional information on standbys.
- Always remove or disconnect all electrical power to the aircraft during fuel cell maintenance.
- Isolate and rope off the aircraft while fuel cells are open.
- Ensure that sufficient fire fighting equipment is available when performing maintenance that exposes fuel to the atmosphere.
- Avoid spilling oil on painted surfaces and components.
- Avoid skin contact when working with fuels and synthetic oils.
- Clean up all fuel and oil spills immediately. **Note:** Stop work immediately in the case of fuel spills and use the hazardous spill unit only for clean up.
- Do not drain fuel sumps in the hangar.

# Chapter 10

***Quality Assurance and Documentation Procedures***

**For the purpose of this manual, corrective action is defined as the work required to eliminate a recorded discrepancy.**

10.1 Inspections

- The Crew Chiefs are responsible for performing daily preflight and post-flight inspections and documenting the results on either a printed guideline with sign-off spaces or a checklist. In either case, a LF 781A must be completed. A preflight inspection is required before the first flight of the day. Support is available from the Quality Assurance Office upon request.
- The Quality Assurance Office is responsible for specifying major and minor inspection intervals as well as specifying the plus or minus limit used to calculate the allowable inspection over-runs. **Note:** The Director, RSD may release any aircraft beyond its limit and only if a need exists that is sufficiently urgent to meet program needs. Refer to Section 10.5 for information regarding exceptional releases. In no case may an aircraft be released for flight if safety is jeopardized.
- The Crew Chief and/or the Senior Maintenance Technician must meet with the assigned Quality Assurance Office representative to conduct a pre-dock inspection review. All forms and permanent records, required inspections, modifications, aircraft manuals, and other additional maintenance requirements will be reviewed for completeness, currency and accuracy at this time.
- The Crew Chief is responsible for entering any information pertaining to Time Change Technical Orders (TCTO), Modification Work Orders, Service Bulletins, Service Letters, or other technical publication modifications on the LF 781A upon receipt.
- All completed forms/packages must be turned into Quality Assurance Office prior to the FRR.

10.2 Symbols

**Red X:** Indicates that the aircraft is considered unsafe for immediate flight and must not be flown until the condition has been corrected.

**Circle Red X:** Normally used only for Army aircraft and as directed by the Modification Work Orders.

**Red Dash:** Indicates that a required maintenance check, scheduled inspection, accessory replacement, operational check, or functional check flight is required and has not been completed. Because the completion of this action could lead to the discovery of a Red X condition, the work must be completed as soon as possible.

**Red Diagonal:** Indicates that an unsatisfactory condition exists, but is not considered urgent or dangerous enough to warrant grounding the aircraft.

10.3 Entering and Clearing Symbols

The LF 781A is updated with discrepancy symbols and a description of the discrepancy when:

- A discrepancy is found during maintenance of inspection activities. The person discovering the discrepancy is responsible for updating the LF 781A. See LMS-OP-0912 for information concerning aircraft maintenance and flight release reporting.
- A TCTO or other directive mandates the update. See LMS-OP-0911 for information concerning review and reporting requirements for Airworthiness Directives. The Quality Assurance Office is responsible for reviewing the directive. The Crew Chief is responsible for updating the LF 781A as directed by TCTO or AD.

- The Quality Assurance Specialist must inspect all repairs made to correct a Red X condition. The Head, RSIB or the Senior Maintenance Technician may clear a Red X condition only if a Quality Assurance Specialist is unavailable and only if the aircraft is urgently needed to meet programmatic milestones. The "inspected by" block of the LF 781A must be signed by the individual performing the inspection and the last name initial placed over the symbol. **Note:** Do not transcribe a Red X or a Circle Red X to the LF 781K for any reason.
- All inspections or modifications that require entries on the LF 781D, LF 781E, or LF 18 must have a Quality Assurance Specialist's signature. Exceptions may be granted by the Lead, Quality Assurance Office for aircraft away from LaRC.
- Red Dash or Red Diagonal entries must be signed by the person clearing the discrepancy and the last name initial placed over the symbol.
- The Quality Assurance Office is available for inspection and sign-off of all work, regardless of symbol, upon request by RSIB personnel.

## 10.4 Changing of Symbols

Symbols must be upgraded if:

- The physical condition worsens.
- Judgment dictates a change in severity.
- The time limit for completion of activities mandated by a TCTO has expired.

Refer to Table 10.3 for instructions on processing symbol changes to the LF 781A.

## 10.5 Exceptional Releases

The Director, RSD, has the authority to grant an exceptional release. Any aircraft with a Red X condition must be downgraded appropriately, re-entered in the discrepancy block of the LF 781A with the downgraded symbol, and an exceptional release stamp placed in the "corrective action" block of the LF 781A by the Director, RSD. See LMS-OP-0912 for additional information on exceptional release. Examples of exceptional release conditions are:

- An aircraft being flown with a time change component overdue for replacement
- An aircraft being flown with a periodic inspection overdue
- An aircraft being flown with a pyrotechnic device overdue for replacement
- An aircraft being flown with parachutes overdue for repack

Documentation of an exceptional release consists of:

- Entry on the LF 781A of the period of hours, flights or calendar time for which the release is granted
- Expiration of the specified period and upgraded symbol to Red X
- A description of the exceptional release conditions and an exceptional release stamp must be entered in the aircraft maintenance section of the Aircraft Operational Report (LF 115) and signed by the Director, RSD. **Note:** The LF 115 must be signed each day prior to flight. A memo detailing the exceptional release conditions and approvals may be substituted for flights longer than one day. A copy of this memo, with original signature of all approving authorities must be filed with the Quality Assurance Office prior to the first day's flight.

## 10.6 Major and Minor Inspection Compliance

*Major inspections* are classified as periodic (PE) or phase (PH) type and are the inspections complied with on LaRC aircraft. The following aircraft are coded either PE or PH:

| Aircraft | Code | Aircraft | Code |
|---|---|---|---|
| UH-1H | PH | | |
| Be-200 | PH | Col. 300 | PH |
| C-206H | PH | SR 22 | PH |
| OV-10A | PH | | |

**Table 10.1**

Code PE denotes a major inspection that is calculated from the completion of the last major inspection. For example, a major inspection completed at 100 aircraft hours would then be due at 200 aircraft hours. Hours between inspections for this classification will be gained or lost using these calculations.

Code PH denotes a major inspection that is calculated from the specified interval. For example, a major inspection with a specified interval of 100 aircraft hours that was completed at 90 aircraft hours would be due at 200 aircraft hours. Hours between inspections for this classification will be gained or lost using these calculations.

*Minor inspections* are inspections that are due at specified intervals within the time intervals of the major inspections. Minor inspections are calculated from specified intervals. Hours will be gained or lost under this concept. Only the Lead, Quality Assurance Office has the authority to alter these inspection concepts.

10.7 Aircraft Inspection Requirements

| Aircraft | Type of Inspection | Time Interval | Inspection Standards | Authorized LaRC Limits |
|---|---|---|---|---|
| | | | | |
| SR 22<br>NASA 501 | 100 Hour<br>Annual | 100 Hour<br>12 Month | Cirrus<br>Cirrus | (+/-) 10.0 Hours |
| | | | | |
| C-206H<br>NASA 504 | 100 Hour<br>Annual | 100 Hour/200 Hour<br>12 Month | Cessna<br>Cessna | (+/-) 10.0 Hours |
| | | | | |
| Col. 300<br>NASA 507 | 100 Hour<br>Annual | 100 Hour<br>12 Month | Lancair<br>Lancair | (+/-) 10.0 Hours |
| | | | | |
| OV-10A<br>NASA 524 | 100 Hour/Phase<br>ACI | 100 Hour<br>Annual | Air Force<br>NASA | (+/-) 10.0 Hours<br>(+/-) 1 Month |
| | | | | |
| Be-200<br>NASA 529 | 100 Hour<br>200/Phase | 100 Hour<br>200/24 Months | NASA<br>Beechcraft | (+/-) 10.0 Hours<br>(+/-) 10.0 Hours |
| | | | | |
| UH-1H<br>NASA 535 | 100 Hour/Phase | 100 Hour/24 Months | NASA/Army | (+/-) 10.0 Hours |
| | | | | |
| | | | | |
| | | | | |

**Table 10.2**

Use table 10.2 to schedule the inspection interval for all LaRC aircraft. Only the Lead, Quality Assurance Office, with concurrence from the Director, RSD, has the authority to modify the inspection intervals outlined above.

## 10.8 Aircraft Forms

The aircraft operated by LaRC fall into the following categories: Army, Navy, Air Force and Civilian. A system of LaRC forms has been developed for our operations. Many of these forms are a modification of the Air Force 781 system of documentation. The Air Force Technical Order 00-20-5 can be used as a general guide for completing the LaRC 781 forms. All Crew Chiefs must use these forms unless otherwise instructed by the Quality Assurance Office. The following is a list of forms and the accompanying procedures to provide guidance for completing the indicated forms.

| FORM NUMBER | USE | INSTRUCTIONS |
|---|---|---|
| LF 781A | Aircraft Maintenance Discrepancy/Work Record | This form must be used to document all maintenance and inspection actions. Maintenance personnel are responsible for assuring that all entries have the designated symbol. Each Monday, the Crew Chiefs will transcribe all open discrepancies to a new LF 781A and the previous week's form will be turned in to the Quality Assurance Office, except during major inspections and during prolonged down times required for major modifications or upgrades. The Crew Chief must route this form through the Senior Maintenance Technician or the Site Supervisor for review and then they will forward it to the Quality Assurance Office. During major inspections or extended down times, a single sheet stating the reason for the extended down time may be submitted instead of transcribing the original LF 781A. A fully transcribed LF 781A must be routed monthly for all aircraft down for extended periods. Upon completion of major inspections or modifications, the LF 781A will be turned in to the Quality Assurance Office prior to the Flight Readiness Review and to the aircraft being released for flight. No form turn-in is required when aircraft are in a storage status, although the aircraft records must be reviewed and overdue inspections must be entered in the LF 781A.<br><br>Discrepancies that are considered non-safety of flight items can be transcribed to the LF 781K. Overdue inspections and Red X items must never be transcribed to the LF 781K. Inspections, TCTOs, MWOs, SBs, and ADs, accessory replacements or other actions that require permanent record entries in the LF 781D, LF 781E, LF 18 must be underlined in red and require a Quality Assurance Office signature. Any discrepancy that is transcribed or carried forward must be noted in the "corrective action" block, signed, and dated.<br><br>Only the Lead, Quality Assurance Office, or the Head, RSIB have the authority to downgrade a symbol and only if the unsatisfactory condition is less serious than the symbol indicates. |
| LF 781D | Calendar and Hourly Item Inspection Record | This form must be used to track calendar and hourly inspection items. The original must be initiated and maintained by the Quality Assurance Office. Information for updating the form is obtained from LF 781A entries and recorded by the Quality Assurance Office. When a change is made, a copy of this form is forwarded to the Crew Chief. The Crew Chief is responsible for reviewing this form weekly and for entering items on the LF 781A when they are due. |
| LF 781E | Replacement Overhaul Record | This form is used to track items that require periodic replacement or overhaul. The original must be initiated and maintained in the Quality Assurance Office. Information for updating this form is obtained from LF 781A entries and recorded by the Quality Assurance Office. When a change is made, a copy is forwarded to the Crew Chief. The Crew Chief is responsible for reviewing this form weekly and for entering items on the LF 781A when they are due. |

| FORM NUMBER | USE | INSTRUCTIONS |
|---|---|---|
| LF 781H | Aircraft Flight Status and Maintenance Record | This form is used in conjunction with LF 115 to record flight time and to track aircraft servicing and minor inspections. Flight times and cycles from the LF 115 are entered in the appropriate blocks and the completed form is forwarded to the Quality Assurance Office at the completion of each day's flights. Pilots are not required to sign the release block if the LF 115 is being used. |
| LF 781K | Aircraft Delayed Discrepancy Record | These forms are used to record aircraft discrepancies that are considered non-flight critical and were transcribed from the LF 781A. The original must be initiated and maintained by the Crew Chief. When a new LF 781K is initiated, the old form from which discrepancies were transcribed is forwarded to the Quality Assurance Office. |
| LF 781LA | Crew Chief Inspection Items | This form is used by the Crew Chief to track recurring inspection items not tracked by the Quality Assurance Office. For example, oil samples, special inspections, and servicing. The form must be initiated and maintained by the Crew Chief. |
| LF 781LB | Aircraft/Engine APU Flight Record | This form is used by the Crew Chief to record airframe time, engine time, engine cycles, and landings. It must be maintained by the Crew Chief and forwarded to the Quality Assurance Office when complete. |
| LF 781LC | Experimental Equipment Log | This form is used by the Crew Chief to record removal and re-installation of already approved experimental equipment. Prior to flight, the crew must verify that all items removed and reinstalled are correctly installed and that electrical plugs and wires connected to items still removed have been secured for flight. The Quality Assurance Office representative must inspect and sign items recorded on this form prior to flight. |
| LF 781LD | Aircraft Inspection and Maintenance Work Sheet | This form is used to document aircraft inspections. This form has space for recording discrepancies found during the inspection. Items signed off on this sheet do not need to be entered on the LF 781A. However, the highest open symbol must be entered on the current LF 781H.<br><br>With prior Quality Assurance Office approval, other preprinted inspection guides can be used if there is space provided for sign-off. These forms must be reviewed by the Quality Assurance Specialist prior to inspection and be initialed after completion. There must be no open items on this form at the completion of the inspection. Any inspection item or discrepancy that is not cleared must be transcribed to the LF 781A. Completed forms must be attached to the LF 781As for turn-in.<br><br>At the discretion of the Senior Maintenance Technician, these forms can be used for daily preflight and post-flight inspections. When used for this purpose, any discrepancies discovered must be transcribed to the LF 781A. Also, when used in this manner, the form must not be forwarded to the Quality Assurance Office, but maintained with the Crew Chief. |

| FORM NUMBER | USE | INSTRUCTIONS |
|---|---|---|
| LF 781LE | Flight Maintenance Inspection Record | The Quality Assurance Specialist at the completion of each scheduled type inspection initiates this form. This form must list all discrepancies discovered during the inspection. The form must be initiated even if zero defects were discovered.<br><br>The original must be initialed by the technician and the Quality Assurance Specialist when faults are corrected or transcribed to the LF 781A. No items are allowed to be left open. The completed form is signed by the Senior Maintenance Technician or the Site Supervisor and initialed by the Head, RSIB prior to being forwarded to the Quality Assurance Office. The original must be filed in the particular aircraft inspection book in the Quality Assurance Office. |
| LF 781LF | Aircraft Work Order and Progress Report | This form is used with Aircraft Work Orders to describe installation of research equipment, instrumentation installation, and modifications to the aircraft. It is filled out daily by the technician completing the work, specifying such items as equipment installed, weights, station numbers, type and size of wiring, wire routing, etc. This will allow a particular segment of the work to be signed off by a Quality Assurance Specialist as it is completed. Completed sheets are attached with the completed work orders and forwarded to the Quality Assurance Office.<br><br>The progressive work sheets are also used for aircraft maintenance or modifications that require extensive tear-down of aircraft or components. If the form is used for this purpose, it is attached to the LF 781A. |
| LF 115 | Aircraft Operational Report | Both maintenance personnel and pilots use this form. The maintenance personnel must report any significant discrepancies that exist or that were corrected from the previous flight. Preflight personnel from avionics, experimental and/or DAS must initial the completion of the checks. The Crew Chief must ensure that the checks have been previously initialed prior to his sign-off and prior to the aircraft being reported ready for flight release to the Senior Maintenance Technician, Site Supervisor or Designated Lead. The Crew Chief is responsible for transcribing flight times, landings, and cycles to the LF 781H, LF 781LB, and all flight reported discrepancies to the LF 781A after completion of flight operations for that day. |
| LF 432 (pg 1 & 2) | Research Vehicle Work Order Request and Approval Form w/continuation sheet | See LMS-CP-0910 for instructions on the use and completion of this form. Individuals use this form when modifications to aircraft are requested. This form must be received by the Crew Chief prior to the requested work being performed. |
| LF 233 | Aircraft Work Order Log | This form provides a status listing of work orders issued for an aircraft. The form is initiated by the Crew Chief and when a work request is received, the required information is entered on the form. The "complied with" blocks are initialed by the Crew Chief and the Quality Assurance Specialist whenever the work request has been completed. This form must be kept with the 781 aircraft forms and will remain a part of that record. |

**Table 10.3**

# Chapter 11

***Foreign Object Damage Program***

11.1 Application

The LaRC Foreign Object Damage (FOD) Program applies all personnel performing maintenance and inspection activities on all aircraft. Aspects of the program will be used for aircraft operations both at LaRC and away from Center.

11.2 FOD Explained

FOD is damage to, or malfunction, of an aircraft caused by a foreign object. The object may be foreign to an area or system and may be ingested by, or lodged in a mechanism. Examples include ingestion of loose hardware by an engine, flight controls jammed by hardware or tools, and tires cut by debris on the ramp or taxiway.

11.3 Causes of FOD

- Failing to maintain a clean work area
- Not keeping full account of hardware, tools and materials
- Improper installation of rivets, screws, and fasteners in the area of engine intakes
- Ingestion of debris by operating engines
- Debris on ramps, taxiways and hangar floors

11.4 FOD Prevention

- Pick up loose objects and put them in the designated place
- Account for all tools and hardware at the beginning and end of a task and at the end of the work day. Refer to Chapter 14 for information on tool control.
- Carry out all helicopter power checks performed in a hover in an area free of debris
- Use care when in the vicinity of the jet blast to avoid blowing debris
- Monitor engine power settings during taxi and turns to avoid blowing debris

11.5 FOD Inspections

Inspections of the ramp area and taxiways must be performed annually. In addition to the annual inspection, a ramp walk and inspection is conducted semi-weekly by RSIB personnel. The taxiways are inspected daily for the presence of debris and condition. The Head, RSIB must be notified of any repairs needed to the ramp and taxiways. It is the responsibility of the Head, RSIB to coordinate repairs of the ramp and taxiways.

Plant support personnel and/or the Air Force are available to sweep the ramp and taxiways upon request.

11.6 Training

The Head, RSIB, acting as the Director, RSDs' delegate, is responsible for conducting safety briefings on FOD prevention and awareness on a yearly basis. Attendance is recorded for inclusion in the employee's training records. These records are maintained in accordance with the RSD Record Form.

# Chapter 12

***Oil Analysis Program***

12.1 Program and Frequencies

It is the responsibility of RSIB Technicians to perform oil sampling to determine the type and amount of wear metal in the oil. Refer to Table 12.1 for the sampling intervals.

It is the responsibility of the Head, RSIB and the Lead, Quality Assurance Office to review all sample results and recommended course of action received from the oil analysis laboratory. It is the responsibility of the Head, RSIB or the Senior Maintenance Technician to advise the Crew Chief of any changes in sampling.

Oil from aircraft engines and other selected components must be analyzed at intervals determined by the Head, RSIB, with the concurrence of the Lead, Quality Assurance Office.

Consult with the Lead, Quality Assurance Office or the Head, RSIB for instructions related to unscheduled sampling.

12.2 Oil Samples

- Collect one large bottle from each unit following the original equipment manufacturer's recommendations
- Record the sample in the Oil Sample Log
- Package the sample using approved containers only and forward to the approved oil analysis laboratory

Oil Sample Frequencies

| Aircraft | Sample Source | Interval |
|---|---|---|
| SR22 NASA 501 | Engine | 25 Hours |
| C-206H NASA 504 | Engine | 25 Hours |
| Col. 300 NASA 507 | Engine | 25 Hours |
| OV-10A NASA 524 | Engine | 10 Hours |
| Be-200 NASA 529 | Engine | 25 Hours |
| UH-1H NASA 535 | Engine | 12.5 Hours |
| | 42 deg. Gear Box | 25 Hours |
| | 92 deg. Gear Box | 25 Hours |
| | Transmission | 25 Hours |
| | Hydraulic System | 25 Hours |

**Table 12.1**

# Chapter 13

## *Battery Maintenance*

All aircraft assigned to LaRC shall have nickel cadmium (Ni-Cad) or lead acid type batteries installed as basic aircraft system DC power. It is the responsibility of the Electronic/Avionics Unit to maintain all batteries for LaRC aircraft DC power as well as specialty batteries for: INU, IRU, ADAIRS, flight control, and aircraft emergency exit lights. The Crew Chief shall be responsible for reviewing the LF 781s for battery capacity test and deep cycle due dates and removing and reinstalling the batteries in the aircraft. Batteries other than basic aircraft, such as experimental or research equipment batteries must have an approved maintenance/inspection plan approved by QAO, and RSIB.

### 13.1 Inspection

The Electronic/Avionics unit is responsible for conducting capacity checks on all aircraft Ni-Cad batteries every 90 days and disassembling and deep cycling on a yearly basis and responsible for all Lead Acid battery maintenance and inspection. Refer to LMS-TD-0957 and LMS-TD-0965 respectively for information on servicing these batteries. **Note:** No service is required for aircraft scheduled for modifications or extensive down time exceeding 90 days. **Note:** All specialty batteries must be maintained in accordance with the manufacturer's specifications.

Responsibilities for battery inspection include:

- The Crew Chief is responsible for meeting with the Electronic/Avionics Unit prior to the inspection due date to schedule battery maintenance.
- The Crew Chief is responsible for making all log book entries to include: battery type, serial number, next inspection due date and re-installing the battery upon completion of all inspections.
- The Crew Chief is responsible to ensure that all battery temperature monitoring systems are operationally tested when a battery is removed, replaced or reinstalled.
- The Electronic/Avionics Unit is responsible for inspecting returned batteries and determining if the battery is suitable for re-installation or must be replaced.
- The Quality Assurance Specialist is responsible for verifying all log book entries and signing the "inspected by" block on the LF 781A.

The Crew Chief must inspect the quick disconnect plug as follows:

- Inspect the contacts for corrosion, arcing, contamination, looseness, and evidence of excessive heat.
- Inspect shells for cracks or breaks.
- Inspect the hand wheel and the engage-disengage shaft for looseness, bent, or other physical damage.
- Inspect the connector for the correct insulation sleeves, (Connector P/N BD6-3 only). **Note:** Repair or replace any connector having sleeves other than white, having damaged sleeves or no sleeves at all.
- Clean contacts with a stiff, non-metallic brush, using either isopropyl or ethyl alcohol. **Note:** If contacts cannot be cleaned, replace the connector.
- Apply a light film of MIL-S-8660 silicone compound (Dow Corning 4) to spiral contacts.
- Perform the following test on battery quick disconnects which incorporate spiral type contacts typical of the Elcon BD6-3 utilizing the battery connector GO/NOGO gage:
  (1) Fully insert the large end (0.385" diameter) of the gage into the contacts and then remove the gage from the connector.
  (2) Fully insert the small end (0.370" diameter) of the gage into the contacts of the connector and measure the force required to remove the gage with a pull scale. **Note:** Replace any connectors that required 0.5 pounds of force or less to remove the gage.
- Perform the following test on the battery quick disconnects which incorporate finger type contacts typical of the Elcon BD6-3Q, Anderson Power Products MS3349-1, and the Rebling P/N 7007 connectors utilizing the battery connector GO/NOGO gage:
  (1) Fully insert the small end (0.370" diameter) of the gage into the contacts of the connector and measure the force required to remove the gage with a pull scale. **Note:** Replace any connectors that required 0.5 pounds of force or less to remove the gage.

# Chapter 14

## *Tool Control Program*

The LaRC Tool Control Program applies to all RSIB personnel and to all individuals performing maintenance or modifications on LaRC aircraft.

Tool Control is a method established by which a technician has the capability of monitoring and accounting for personal tools used to perform aircraft and research equipment maintenance tasks.

### 14.1 Training

The Director, RSD and Head, RSIB are responsible for ensuring a discussion of tool control is included on the annual FOD program presentation agenda. Topics of discussion must include an understanding of why tool control is required and the hazards associated with incorrect tool control. Attendance is recorded for inclusion in the employee's training records. These records are maintained in accordance with the RSD Record Form.

### 14.2 Tools and Control Procedures

RSIB personnel are required to provide their basic hand tools with specialty tools being provided by RSIB. All tools must be of high quality, well manufactured, and with superior quality plating that resists cracking and flaking. Personnel are expected to use a toolbox or other suitable storage container for their tools.

The Crew Chief is responsible to ensure that all personnel outside of RSD practice tool accountability when working on aircraft and conduct an inspection of all work areas at the completion of maintenance tasks to ensure all tools have been removed. The Crew Chief is responsible for notifying the Head, RSIB immediately of any tool control problems.

Control all tools as follows:

- Engrave initials or name on all tools.
- "Shadow board" all tool boxes.
- Maintain a current inventory of all tools stored in the tool box.
- Use a LF 314 "Toolbox Accounting Checklist" for tools not “shadow boarded” whenever a task is performed. The use of inventory list with area to list consumables may be used in place of LF 314, if approved by Senior Maintenance Technician or Site Supervisor. The following must be included on the checklist:
    1. aircraft number
    2. task
    3. work area
    4. date
    5. tools being used
- Return all tools to the tool box at the end of the task or workday, whichever comes first.
- Verify all tools have been retrieved from the work area using the LF 314 "Toolbox Accounting Checklist" or shadow board and inventory list.
- Sign and date at the end of the day or shift the LF 314, inventory list, or LF 422, Tools and Consumables Checklist, as appropriate.
- Retain the completed forms when full for 90 days and then destroy.

### 14.3 Unaccounted-for Tools

- The technician is responsible for notifying the Senior Maintenance Technician or the Site Supervisor for the Contract Support Aircraft Team of any tools not accounted for at the end of the task or work day.
- The technician must enter a discrepancy on the LF 781A Aircraft Maintenance Discrepancy/Work Record describing the incident and assign a Red X symbol.
- The technician is responsible for conducting an immediate search for the tool.

- The Senior Maintenance Technician or the Site Supervisor for the Contract Support Aircraft Team is responsible for notifying Quality Assurance Office of the missing tool and requesting assistance in the search.
- The technician, with concurrence and signature of the Quality Assurance Office, must clear the Red X condition once the missing tool has been accounted for.

**Note:** The Head, RSIB, with concurrence of Quality Assurance Office is responsible for resolution and documentation on the LF 781A of any tool that cannot be found.

### 14.4 NASA Supplied Tools

All tools and equipment owned by NASA and used by technicians must be checked out from either the RSIB stockroom or the Quality Assurance Office and returned at the end of the task or workday, whichever comes first. The technician is responsible for verification of current inspection and calibration stickers prior to use of equipment checked out. See LMS-CP-0506 for information on maintenance and calibration of NASA-supplied tools that must be calibrated.

### 14.5 Torque Wrench Verification

All torque wrenches must be maintained in the RSIB Stockroom and verified prior to use using the appropriate Torque Wrench Tester. See LMS-CP-0506 for information on maintenance and calibration of the Torque Wrench Tester.

### 14.6 Equipment Usage Tag

An Equipment Use Log tag will be attached to all Category 1 equipment. When the equipment is used, the user will complete the tag, providing date, aircraft number, system, and signature. When the tag has all lines completed, the tag will be turned into the equipment controller, Avionics, Stockroom, or QAO for handling until the equipment is sent in again for calibration. After calibration is completed and the new data reviewed, the old tags can be filed as historical records. A new tag will be attached to the equipment when returned from calibration.